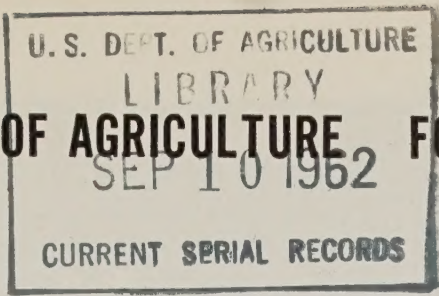


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Red Turpentine Beetle

By Richard H. Smith¹

The red turpentine beetle (*Dendroctonus valens* Lec.) is the largest and most widely distributed bark beetle in North America. It belongs to a group that characteristically mines between the bark and wood of trees. Some of its closest relatives are the most destructive known killers of coniferous trees.

The red turpentine beetle is a common pest of forest, shade, and park trees of pole size or larger. It has been recorded from at least 40 species of domestic and foreign conifers. Yet, despite the abundance and wide distribution of this beetle, outbreaks have been neither extensive nor severe. The red turpentine beetle has been found most

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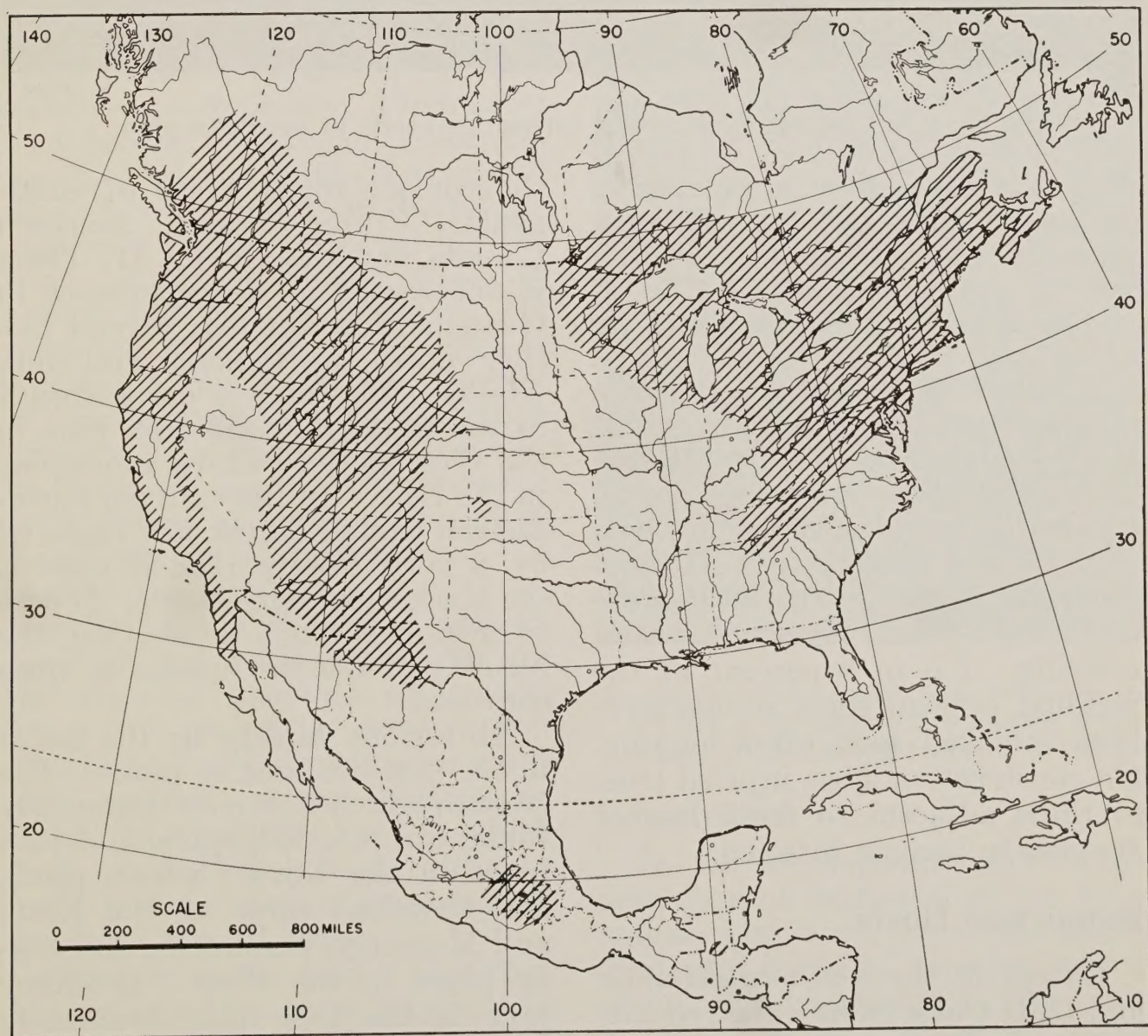
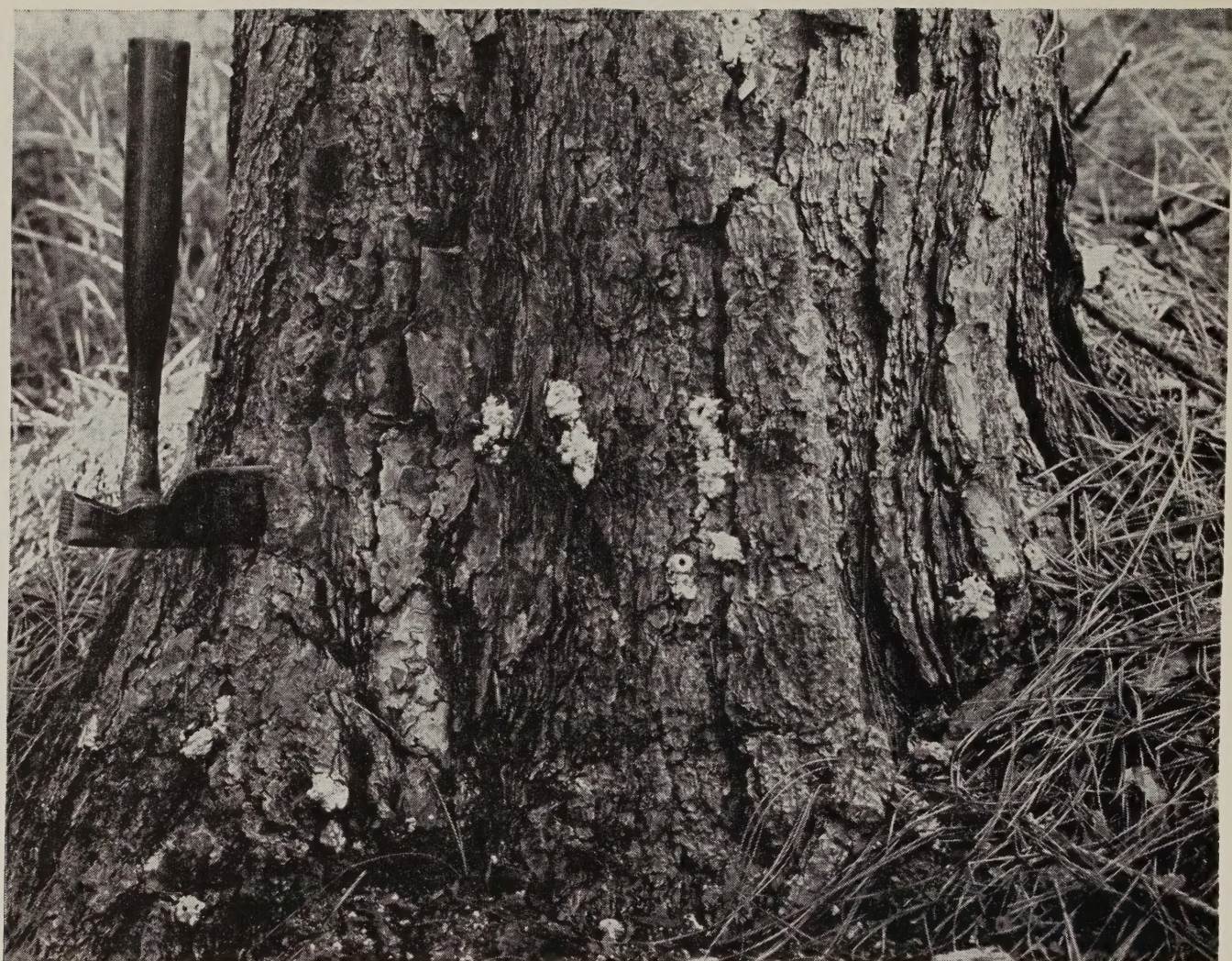


FIGURE 1.—Generalized range of the red turpentine beetle.



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FIGURE 2.—Pitch tubes of the red turpentine beetle at base of a pine.

frequently in individual trees or in groups of trees in localized areas. Pines are the most common host by far.

The insect usually attacks trees of reduced vigor or those infested with other bark beetles, but it can attack apparently healthy trees. It is especially destructive to Monterey pine, and in some park areas in California has attacked as much as 15 percent of this species. At times the insect is also destructive in areas disturbed by fire, logging, or land clearing. Up to 3 percent of the residual pine in some stands have been attacked soon after logging. On construction sites, injured trees or those adjacent to fresh lumber frequently become infested.

Range and Hosts

Except in the southern Atlantic and Gulf Coast States, the red turpentine beetle may be found in all

the conifer forest areas of continental United States, southern Canada, and Mexico (fig. 1). There is one record of its occurrence in Guatemala, and it may extend farther north in Canada and into Alaska. Its range is quite similar to the range of ponderosa pine in the West and of eastern white pine in the East. In the extreme southeastern United States, it is replaced by a very closely related species, the black turpentine beetle. Where their ranges touch or overlap, the identity of the two species is often confused.

All serious damage by the beetle in the past has been to pines. The trees in which it is most frequently found are red, lodgepole, and jack pines in the North; white, pitch, and shortleaf pines in the East; and Monterey, ponderosa, and sugar pines in the West. Monterey pine is the tree most frequently killed and ponderosa pine is most

frequently attacked, according to existing records. Attacks on the other genera of conifers—spruce, larch, true fir, and Douglas-fir—are infrequent and have never been serious.

Evidence of Attack

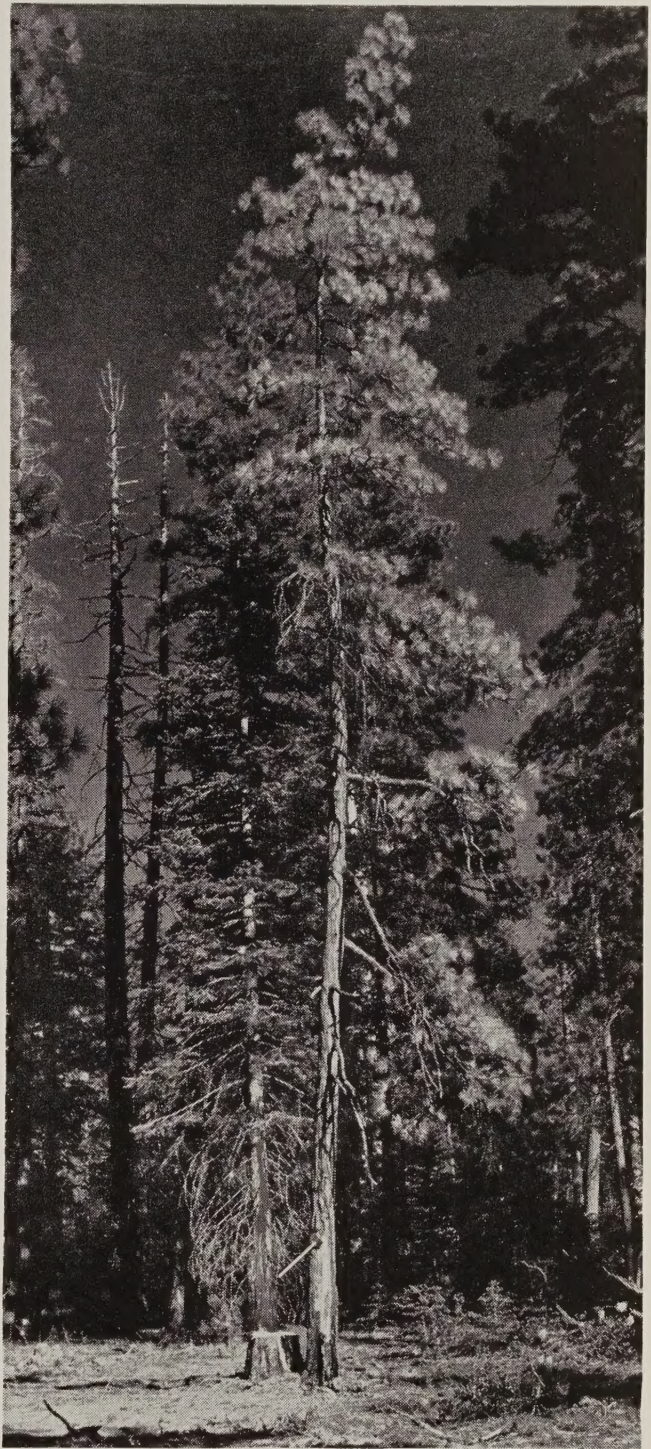
Attacks of the red turpentine beetle are concentrated in the basal 6 feet of the tree, though an infrequent attack may be made above a height of 12 feet. Indicators of an attack are a pitch tube on the outer surface of the bark (fig. 2), boring particles either in bark crevices or on the ground at the base of the tree, or pitch pellets on the ground.

Resin which flows from the wood, the insect's frass, and bark borings are mixed in the gallery (tunnel) and pushed outside the entrance hole by the beetle. The mixture can either adhere to the bark surface and form a pitch tube or it can fall to the ground in various-sized pitch pellets. Pitch tubes vary in size, texture, and color, depending on the kind of tree and the relative amounts of bark borings and frass embedded in the resin. Resin is usually white to yellow and borings are red. On pines the tubes may be as large as 2 inches across. On other species of trees such as fir or spruce which produce little resin, the tubes may be small or absent, though small pitch pellets or boring dust can be found on the ground around the base of the tree.

Galleries, always located between the bark and wood of the tree, are the internal evidence of attack. They are generally vertical and may be partially packed with granular, reddish, pitchy borings or frass. The galleries vary in width from one-half inch to more than 1 inch, and in length from a few inches to several feet.

Often it is the dying tree that focuses attention on an attack. As the tree dies, the needles first fade

to yellowish green, and then through shades of yellow and sorrel to red (fig. 3). In most cases this fading of the needles is associated with attacks by other insects, primarily bark beetles.

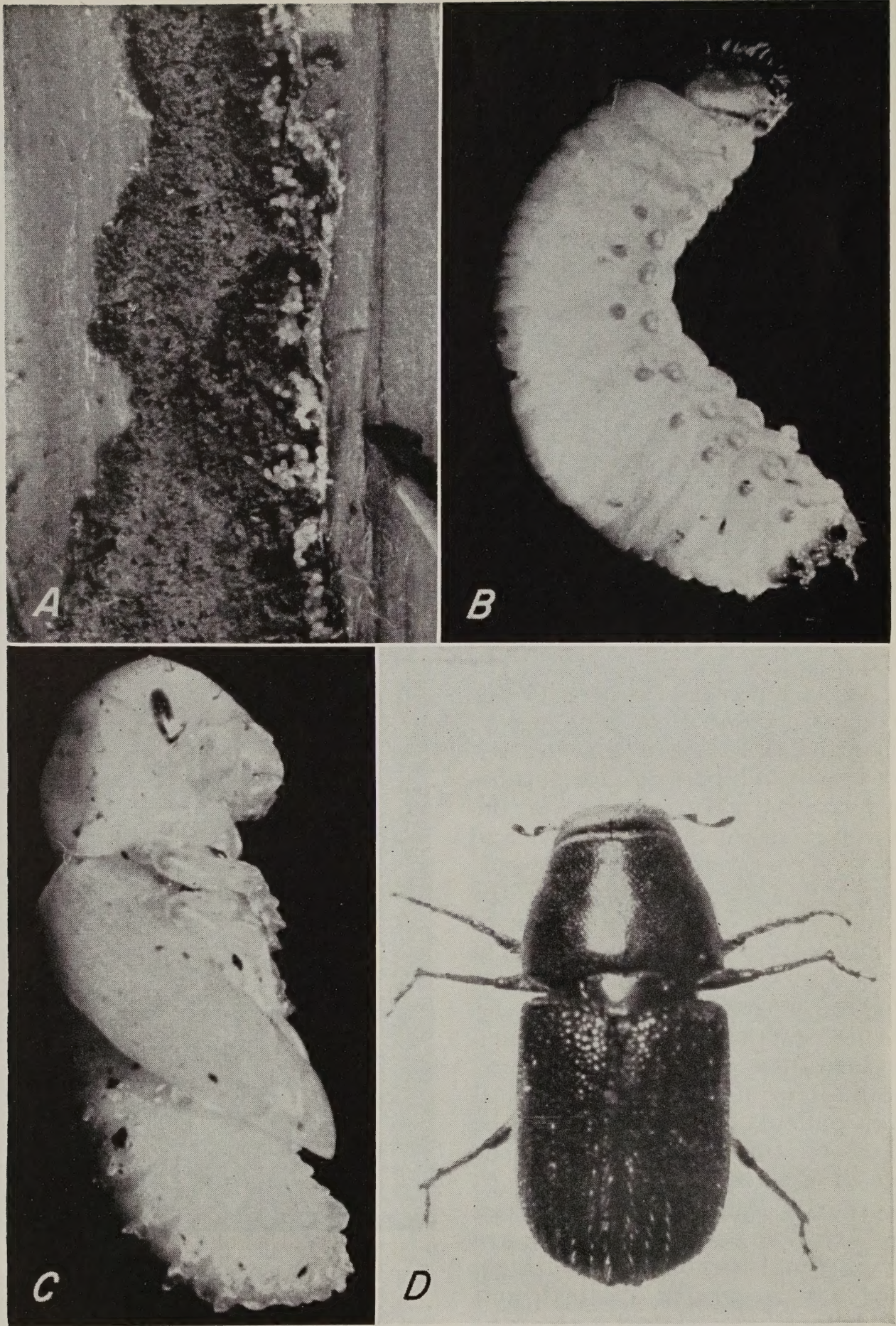


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FIGURE 3.—Ponderosa pine, adjacent to a freshly cut stump, dying after being attacked by the red turpentine beetle.

Description

In the development of this insect, as in all beetles, there are four stages: egg, larva, pupa, and adult. The egg is shiny, opaque white, ovoid cylindrical, and a little over 1 millimeter long (fig. 4, A). The



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FIGURE 4.—Life stages of the red turpentine beetle: A, Pencil pointing to mass of eggs along gallery; B, larva; C, pupa; D, adult.

larva, which hatches from the egg, is grublike, legless, and white except for a brown head capsule and a small brown area at the hind end.

With growth, a row of small, pale brown tubercles becomes evident along each side of the body. The larva may attain a length of 10 to

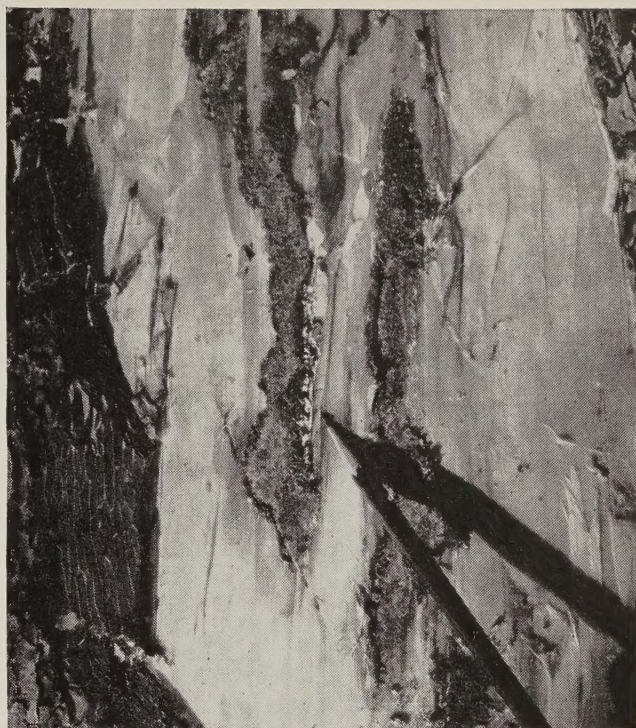
12 mm. when full grown (fig. 4, *B*). It transforms into the pupa, slightly shorter than the larva but still white (fig. 4, *C*). In the pupal or resting stage nonfunctioning wings, legs, and antennae are held against the body. The pupa changes to a beetle, typically 6 to 10 mm. long and quite stout. At first the beetle is tan colored and is called a callow adult, but it rapidly darkens to a reddish brown (fig. 4, *D*).

Life History

The attack starts when the beetle flies to the bark on a tree, root, or stump. Usually, flying activity peaks early in the spring after several warm days. Most beetles come from freshly cut stumps and dying trees. Upon reaching the bark, the female bores inward through the outer corky bark and the inner spongy white bark, called phloem, to reach the wood. She is soon joined by a male. Though they do not bore into the wood, they may score it a bit. Their boring proceeds generally downward, though at first the gallery usually has a lateral or even slightly upward direction. Where attacks are made just above the ground line, the gallery may run below the ground line and along the larger roots. The boring is rapid and may exceed an inch in one day. Usually two beetles, a male and female, are in a gallery; infrequently one to four are present.

Though a small amount of resin is encountered in the phloem, most resin that flows into the gallery comes from the sapwood. The resin, mixed with boring particles and frass, is pushed to the outer surface of the bark. The male seems to have the major responsibility for pushing the frass and resin out of the gallery.

Eggs are laid in an elongate mass along the side of the egg gallery (fig. 5), and are partitioned off



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FIGURE 5.—Adult gallery and eggs of the red turpentine beetle in phloem tissue of ponderosa pine.

from the adult gallery by a wall of pitchy borings. The egg mass can extend from one to several inches along the gallery; the number of eggs in it varies from a few to more than a hundred. A single female may deposit one or more groups of eggs farther along the gallery, usually several inches or more below the previous group. The parent beetles continue to feed in the gallery for several weeks. They then may bore out through the bark and make additional attacks or they may die within the gallery.

In vigorous trees the flow of resin apparently prevents egg-laying. Beetles may remain in these trees for several months, enlarging their galleries laterally or vertically but seldom depositing eggs. Two factors directly associated with the insect's action are sometimes assumed to enhance its success by decreasing the flow of resin from the sapwood of the tree. One is the introduction or invasion of blue-stain fungi and yeasts, which grow in the sapwood surface of the gallery. The other is the lowering of the moisture content of the sapwood as a result of the beetle's feeding activity.

In summer the eggs hatch in 1 to 3 weeks. The small larvae, which emerge from the eggs, feed gregariously away from the adult gallery, always feeding in the phloem tissue between bark and wood (fig. 6, *A*). As they grow, they feed more extensively and make an irregularly margined, fan-shaped gallery (fig. 6, *B*). The larvae literally feed shoulder to shoulder in an irregular line, steadily moving forward into fresh phloem. Their action closely resembles a fire creeping across a dry field. If a well-developed gallery is exposed at its margin, it is not uncommon to find a handful of larvae in just a few square inches. Their feeding thus kills a patch of phloem which can be from a few inches to more than a foot wide.

As the larvae reach their full growth, they make separate cells in which to transform. In constructing these cells, they may scoop out bits of wood or bark. The cells are located between bark

and wood, either in the area of the gallery (fig. 6, *C*) or a short distance forward into the fresh phloem. Here the larvae change to pupae, which in turn transform into adults.

The new adults move about in the gallery area for a few days or more, but in warm weather they soon bore outward through the bark and fly away. Several may use the same exit hole. Mating has been observed after beetles have left the tree. The beetles are capable of flying more than 10 miles. When actively feeding in a tree they may live for several months.

The rate of development of a generation and the number of generations per year are largely dependent on temperature. In the Sierra Nevada of California, the usual developmental periods in summer are about 2 weeks for the egg, 8 weeks for the larva, 1 week for the pupa, and 1 week for the callow adult. In the northern latitudes and higher elevations, 2 years

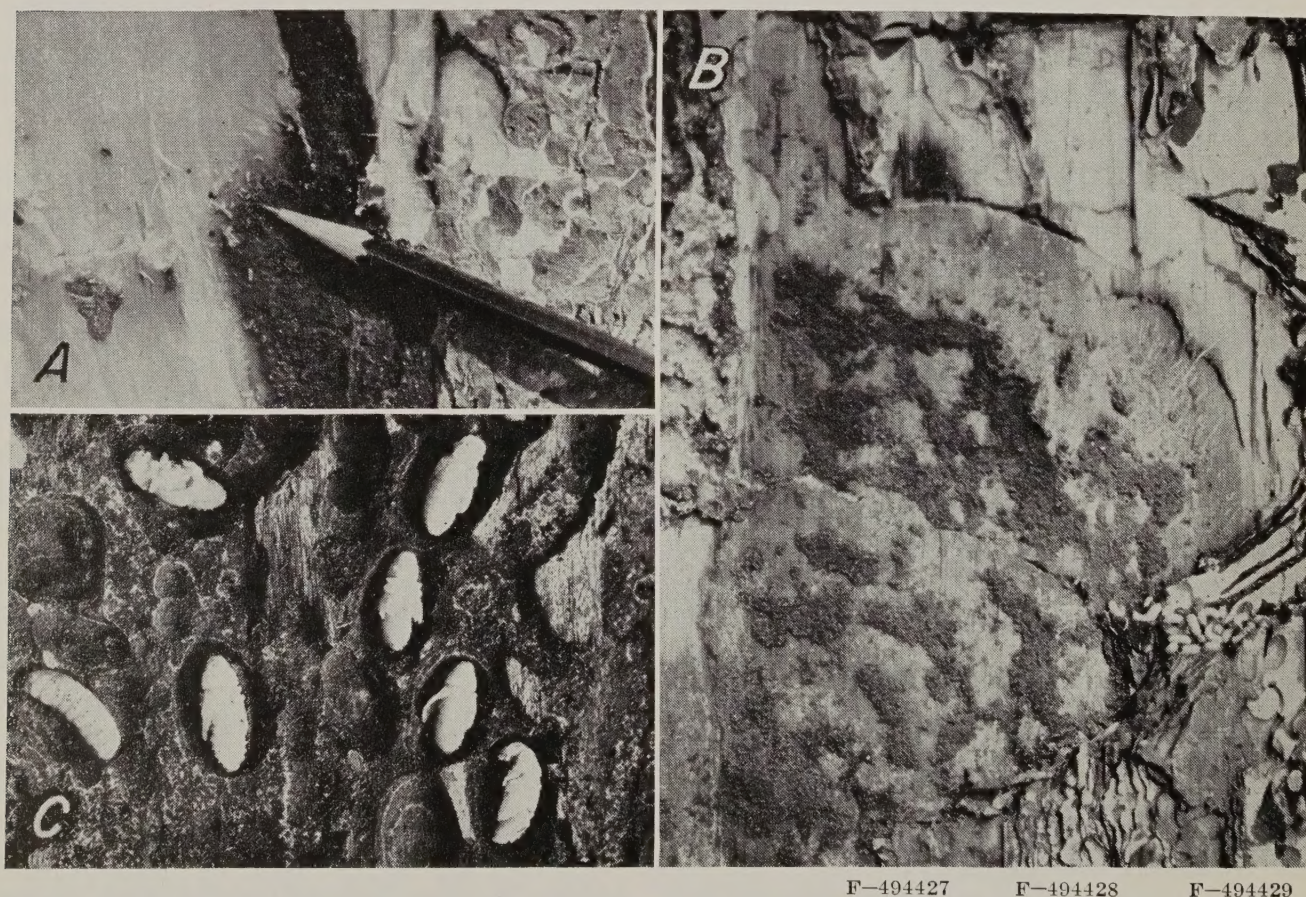


FIGURE 6.—Development of galleries: *A*, Young larvae feeding away from adult gallery; *B*, fan-shaped gallery and $\frac{3}{4}$ -grown larvae (lower right); *C*, pupae and a full-grown larva in cells between bark and wood.

may be required for a single generation, though in most areas there is at least one generation a year. In the southern latitudes and lower elevations, there may be two or three generations in a year.

In the warmer parts of their range, the beetles may fly intermittently during the milder winter months. In the colder parts, the winter is passed in hibernation, chiefly in the adult stage and to a lesser extent in the larval stage. Pupae and eggs rarely overwinter.

Attack Habits

The primary places of attack are freshly cut stumps or the bases of trees that are dying, often from an attack of other insects. In these places, the beetle is most successful in reproducing in large numbers. Though there is no damage under these conditions, the increase in population may be a threat to nearby trees. Fresh-cut logs with thick bark may be attacked but are not considered a source of large numbers of insects.

The second most frequent place of attack is the exposed roots and the base of trees that are weakened by roadbuilding, logging, and land clearing, and drought, fire, lightning, and the activity of other insects. In these situations, the beetles often produce broods and at times kill trees. The beetle may be found in trees where homes have been built in stands of conifers. Such construction activity can weaken many trees, the insect can further weaken them, and some may eventually die. The beetles can persist in such places for more than one season.

The beetles are often attracted to healthy trees near freshly cut logs and lumber, and to stands attacked by other species of bark beetles. Many attacks on apparently healthy Monterey pines result in the successful development of broods.

On healthy trees of other species most attacks are not successful, though exceptions have been noted, particularly in ponderosa and eastern white pine. In attacking healthy trees, the beetle in most instances merely excavates irregular galleries without laying eggs. Such attacks do not kill the tree, but apparently predispose it to the attack of other bark beetles at higher points in the tree.

In Western United States the red turpentine beetle is most frequently associated with the pine engraver beetles (*Ips* spp.) and the western pine beetle (*Dendroctonus brevicornis* Lec.), which often attack trees before the red turpentine beetle does.

Attacks, especially on vigorous trees, may extend over a period of 2 years or more.

Control

The effects of biological factors on the red turpentine beetle are not well understood, and have not been closely studied. Occasionally an insect parasite or predator has been found destroying some of the forms of this insect beneath the bark. Some of the broods observed were apparently being destroyed by a disease. Many beetles die in their attempt to attack healthy trees. Woodpeckers feed on the larvae and pupae. The competition for food within and between broods may also result in reducing the number of larvae. However, little positive control can be accomplished with these natural agencies.

Attention to tree and stand conditions offers some opportunity for applied control. Damage to stands or to individual trees should be prevented. Do not chop into trees, dig up or damage roots, push deep earth fills over roots, or pile lumber or green logs near trees. Watering and fertilizing may improve the condition of a tree and lessen the injurious effect of the beetle.

Trees dying from attack by other insects often serve as good breeding areas for the red turpentine beetle. They should be cut down, and removed from the area or properly disposed of. Freshly cut stumps, another potential source of infestation, should be debarked or sprayed.

Chemical Control

One of the early methods of controlling this beetle was to inject carbon bisulfide into the gallery through the entrance hole in the bark. This chemical volatilizes and kills by fumigation. The method can be used where there is an occasional attack on a tree. It does not prevent attacks.

A better choice of a chemical is benzene hexachloride (BHC). It is a more recently developed insecticide, which can be used to prevent or to remedy attacks. Although it has been used only to a limited extent against this beetle, it has proved effective. Against its close relative the black turpentine beetle, BHC has been applied very successfully and much more widely. It is especially useful on trees of high value, such as shade and park trees.

The procedure is to spray a 1 percent diesel oil solution of the gamma isomer of BHC on the lower part of a tree. This will prevent attacks for several months, probably during one growing season. Also it will kill some of the insect forms that might already be in the tree. If the tree has not been attacked, spray to a height of at least 3 feet. If it has been attacked above a height of 3 feet, spray to the height of the highest attack. It is also helpful to break off the pitch tubes so that the solution can reach the galleries more easily. The solution should be applied at the rate of 1 gallon for about 50 square feet of bark surface. At this rate it will start to run freely down the bark. It is important to apply the spray liberally at the ground line.

An oil solution of BHC must be sprayed with caution. Since it can damage grass and shrubbery, protect them from the spray. It may be necessary to use a 1 percent water emulsion, which is not as effective as the oil solution and does not have its long residual action.

Caution: BHC is poisonous. Store it in a plainly labeled container, away from all food. Follow directions and heed precautions given on the container.